energy is not the only solution of the problem, and it remains for the future to decide which of the two is the more convenient and the more fundamental. The "energetic" system of physical philosophy suffers by being intangible and lacking in imaginative stimulus, whilst the material it makes use of in order to build up a picture of the phenomena of nature is not characterised by the simplicity which is desirable in relations of so ultimate a character.

Returning to the book under review, we find, naturally, that a great deal of it refers to the important investigations on the charge, mass, velocity, and other properties of ions and electrons. These have been described with that excellence which characterises the whole production. The reader will find a particularly satisfactory account of Townsend's very exact investigations on ionisation by collisions.

There is a minor point which may be criticised, and that is the prominence given to Moreau's results on the velocity of ions produced by metallic salts in flames. That investigator found that the velocity of the negative ions varied in an unexplained way with the concentration of the salt and the atomic weight of the metal, whereas H. A. Wilson found it to be independent of both these factors. The editors appear to have overlooked the experiments on this subject of the last-named author.

With this slight exception, we have nothing but praise for the whole work, and heartily congratulate the French Physical Society and all who have been concerned in its production. We hope that they will be able to bring out more volumes of a like kind as the development of the subject proceeds. It will be remembered that a few years ago the French Physical Society published a very important series of memoirs, on all branches of physics, which had been communicated to the International Congress at Paris in 1900. The extraordinary activity of the society in this way must command the admiration and gratitude of physicists in every part of the world.

O. W. Richardson.

ANOTHER PLEA FOR RATIONAL EDUCATION.

On Professional Education, with Special Reference to Medicine. An Address delivered at King's College, London, on October 3, 1905. By Prof. T. Clifford Allbutt, F.R.S. Pp. vi+80. (London: Macmillan and Co., Ltd., 1906.) Price 2*s*. net.

"THERE is no state so perilous as that in which things seem good to us, and at present in England the schoolmaster is complacent, the public indifferent." So Prof. Allbutt generalises early in his address, directing attention, however, in a footnote, to a single exception in the case of the headmaster of the Perse School, Cambridge. Though many more earnest schoolmasters anxious to reform scholastic methods could be named, thoughtful observers of English educational procedure must admit —in spite of the current bickerings among politicians as to religious instruction in elementary schools—that the schoolmaster's policy of *laisser-aller* and the apathy of the public are, and have been, the chief causes of the chaotic and rudimentary state of our secondary education. For half a century it has been dinned into the ears of statesmen, parents, and schoolmasters that no system of higher education, whether academic or technical, can prove successful in the absence of a sane, modern, and broad supply of secondary education given by rationally trained teachers. Prof. Allbutt is to be congratulated upon ranging himself on the side of the prophets, and though for the present he may be a voice crying in the wilderness, his able advocacy of the introduction of sweet reasonableness into our secondary schools will some day be counted unto him for righteousness.

A few of Prof. Allbutt's lessons to the schoolmaster may be quoted with advantage. "The scientific study of facts is the lever by which liberal culture has been re-awakened, and we are beginning to see that the ideas and methods of natural science, instead of being merely curious or commercial, are, if not the flower of education, at any rate the stem and branches." "On both 'sides' [of most schools], while the memory is exercised, and the intellect somewhat called upon, the imagination, the centre of creative life, the source of great action, is left out in the cold." The teacher who fears the baneful effects of specialisation may note this:—"I am satisfied that if the two main coefficients of mind—the intellect and the imagination —are fostered, it proves best in the end to promote development in each person on the lines of his own nature." But we have kept what in our judgment is the most important quotation—trite though the advice is—to the last:—"It is not so much *what* a man is taught as *how* he is taught it."

This advice leads naturally to the consideration of the present secondary school curriculum. Not every essential part of a wide subject can be included in a single address, but it is to be regretted that Prof. Allbutt has so little to say on the simplification and lightening of the absurdly congested time-tables of most schools. It is true that we are told that the current teaching of Greek and Latin is a parody of education, and that, like Sir William Ramsay, Dr. Allbutt considers chemistry is not a good subject for boys, but some guidance in the direction of a ruthless cutting down of the number of subjects at present studied by young boys would have been welcome. It is in this direction that the schoolmaster has a right to look to the man of science for guidance. Cannot physiologists and psychologists agree together as to what groups of faculties should be trained during the years of school-life, and, with the help of pedagogical experts, decide which groups of subjects best assist such training? Until this is done, or until some masterful genius filled with the pedagogic passion arises who will solve this most pressing of educational problems, secondary education will continue to be a process of filling the minds of boys and girls with pellets of information in a multitude of subjects, and of loading the verbal memory with a brecciated congeries of unrelated facts.

On the tertiary, or university, stage of education

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Prof. Allbutt speaks with authority and full knowledge. He points out to the medical student who through comparative indigence has to proceed from the secondary to the medical school without the initiatory university course with which his more opulent contemporary is favoured, that "there is no difficulty, at any rate in university education, in using for general training the broader principles of any one of the professional faculties." Applying his principle already quoted, that it is not what is taught but how it is taught, Dr. Allbutt shows how professional studies may be made sources of culture and broad ideas by the non-university medical student. But there is in no sense a disparagement of the unique value of a good university course, with its chances of intercourse with many types of intellect and the opportunities the student has of learning the best which has been done and said in the world.

The question of examiners and examinations is dealt with also. We are told that "the professional examiner, he who makes it his business to range from place to place imposing mechanical tests wholesale, is one of the new terrors of life." We are not introduced, however, to the evil effects of examinations upon the examiners. The examiners are, in many cases, distinguished men of science who eke out insufficient emoluments by undertaking examining work in their leisure hours—time which, in a rationally organised system that recognised the workman to be worthy of his hire, would be devoted to research work. Enough has been heard of the evil effects of examinations upon students, and, indeed, much has been done in the direction of judicious inspection to remedy these, and it is time to recognise that the employment of eminent leaders in science to do the work which competent teachers can perform better is an improvident use of our best intellects.

We notice, in conclusion, that Prof. Allbutt sums up the end of education to be action. "We learn, that we may do," he says. The educated man must not rest satisfied with his education, and be content selfishly to enjoy the intellectual gratifications placed at his disposal. Like each one of us, the educated man is one member of a complex society with many needs to be satisfied, many abuses to be swept away, many wrongs to be redressed. The privileges the educated man has enjoyed, and the sources of satisfaction his education has revealed to him, should serve as incentives urging him to work for the advancement of his race and the further development of human society.

A. T. S.

A MARE'S NEST.

The Utilisation of Nitrogen in Air by Plants. By T. Jamieson. Pp. 82+18. (Aberdeen: The Agricultural Research Association, 1905.)

MATTHEW ARNOLD has somewhere a finely ironical passage in which he comments upon the British habit of labelling its institutions with a great name without considering whether they possess any great thing to correspond, and certainly the name of "Research" has rarely been more taken in vain than in the present publication. The Agricultural Research Association appears to be a body of gentlemen in the neighbourhood of Aberdeen who maintain certain experimental plots under the direction of Mr. T. Jamieson. It is further assisted by grants from the County Council and from the Board of Agriculture, and it has issued the above report for 1905, heralded by some startling preliminary trumpets in the Scottish Press. Briefly speaking, Mr. Jamieson claims to have "discovered" "that plants generally absorb free nitrogen directly from the air, and transform it into albumen." He proposes to wipe out agricultural science between the dates of De Saussure and himself, writing, indeed, with a curious resemblance to the amateur speculations of sixty years ago.

Mr. Jamieson begins by demolishing, to his own satisfaction, the theory that leguminous plants fix nitrogen by the agency of bacteria, and the quality of his argument may be gauged from the following passage:—"It should be borne in mind, also, that bacteria were *never proved to be present.* The small particles found in the tubercles were merely *assumed* to be bacteria." What are we to say to a man who proposes to dismiss the nineteen years' work of some scores of investigators in every country by denying a fact he could demonstrate to himself at any moment had he the most elementary acquaintance with the manipulation of bacteria? But no; Mr. Jamieson prefers to speculate on his own, without even reading up the subject. There is a curious footnote on p. 29 which, we imagine, is meant to display Mr. Jamieson's acquaintance with the literature of nitrogen fixation; a list of authorities is given, equally amazing as regards either its inclusions, its omissions, or its spellings of proper names. Beyerinck appears variously as Burginck and Beirjerenck. But when we leave Mr. Jamieson's criticism and turn to his constructive work the result is even more amazing. He takes an ordinary plant, spurrey, for example, and finds certain hairs on the leaves. To ascertain the purpose of these hairs he applies to them iodine or some other reagent capable of staining proteid. He finds that the tips of these hairs, which are at first empty and then become green with chlorophyll, give later a reaction for albumen, which disappears again as the hairs age. "If the formation of albumen takes place in the tip of this hair, one would expect to find its absence in the early stage, its presence in the later or active stage, its discharge through the channels and round the cells of the plant, and its possible absence in the latest stages—and this is what has actually been found."

"The evidence that nitrogen is absorbed by these tips, and is there fixed and manufactured into albumen, is thus as complete as could well be desired." "The direct absorption of nitrogen, and its direct fixation as albumen, thus seems demonstrated even more satisfactorily than is possible by chemical analysis," and none, accordingly, is attempted. "'Tis safer so," as the American poet puts it. Mr. Jamieson does not bring forward a single experiment to demonstrate that nitrogen has been fixed by any of his plants; this fundamental fact (?) he assumes.

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